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ABSTRACT

The paper focuses on the need for utilizing current research findings relative to developmental differences in memory and metamemory (knowing about knowing) behaviors among populations of normal and mentally retarded learners. Results of a series of studies which investigated the developmental attributes of memory and metamemory behavior among retarded school aged children are described. Findings are seen to illuminate the strengths and weaknesses of the retarded learner's information organization skills relative to the classroom demands on memory abilities. It is concluded that the retarded child is at least minimally aware of a number of strategic phenomena. In the future, it is suggested that practitioners devise systematic classroom based learning experiences so as to promote development relative to information organization skills if they are to provide effective remedial and compensatory education to developmentally delayed learners. (Author/SBH)

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AN EMIPIRICAL STUDY OF THE DEVELOPMENT OF MEMORY AND METAMEMORY IN MILD AND MODERATELY RETARDED CHILDREN*

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ABSTRACT

The major conerns addressed by this presentation focused on the need for utilizing current research findings relative to developmental differneces in memory and metamemory behaviors among pupulations of normal and mentally retarded learners.

The results of a series of studies conducted by Eyde and Altman (1978) which investigated the developmental attributes of memory and metamemory behavior among retarded school aged children were described. The various experimental memory tasks were examined in terms of their implications for instructional activities in classroom settings. In addition the developmental characteristics of a child's metamemorial knowledge i.e., the retarded learner's awareness of alternative information processing strategies, organizational properties of task materials and mnemonic techniques for facilitating memory were discussed.

The results of the studies taken together illuminated the strengths and weaknesses of the retarded learner's information organization skills relative to the classroom demands on memory abilities. It was concluded that the retarded child is at least minimally aware of a number of strategic memory phenomena. The developmental course of metamemory in mild and moderately retarded children is similar to that of normal children albeit quantitatively and qualitatively delayed. Although retarded learners recognize a wide range of organization strategies, the children in this sample did not spontaneously employ such strategies in a task adaptive manner.

In the future, practitioners much devise systematic classroom based learning experiences so as to promote development relative to information organization skills if they are to provide effective remedial and compensatory education to developmentally delayed learners.

An Empirical basis for the future of Special Educating

It is our common intention as special educators to substantially ameliorate the learning difficulties encountered by our students. However, it has become increasingly clear that if we are to interrupt inadequate learning patterns, we must conscientiously utilize an empirical basis for classroom practices. By and large our past efforts in educational research have centered on the performance differences exhibited by various groups of learners, e.g. the mentally retarded, the specific learning disabled, the behavior disordered, under various instructional conditions. The reported findings from these studies have enabled researchers and practitioners to formulate general statements concerning the learning characteristics of certain groups of students and subsequently generate remedial and/or alternative curricula based on reported learning differences.

More recently and increasingly so in the future, research proposals are shifting attention from group-based differences in learning abilities to the specific learning patterns manifested by individual children on specific learning tasks. Special educators, in particular, are demanding data supportive of prescriptive classroom activities vis a vis appropriate individualized educational plans (IEPs). Concomitant with the interest in individually relevant educational research, there has been an ongoing reformulation of the constructs used to explain differences in learning abilities. Research studies are focusing to a far greater extent on interactive, subject-related variables such as developmental maturity, ability and aptitude for academic tasks and experiential history. Conceptually, researchers are viewing the cognitive systems used for organization

of environment information as operating under the active control and direction of individual learners. Consequently, important age and ability related differences in learning capacity are being identified by basic research activities and the results are being utilized in applied research designs.

The implications of this type of research for present and future understandings of empirically-based classroom activities are far reaching. The potential "ameliorative impact" of these data relative to curricula design, instructional techniques, media and material utilization and general structuring of classroom learning events at this point in time are mostly anticipatory but nonetheless provocative.

General memory awareness in normal children

Brown (1975), for example, in a series of research investigations has recently identified three developmental levels of information processing which have been investigated under the general heading of memory development. These variables may generally account for manifest differences in individual learning efficiency on classroom tasks. She has designated these as developmental levels relative to "knowing," "knowing about knowing," and "knowing how to know." Apparently all three of these forms of cognition undergo both quantitative and qualitative changes in the normal course of development. Observed differences in individual memory behaviors according to Brown (1975) are determined by the extent to which the processing of an environmental or cognitive event is dependent on any or all of these three major knowledge systems. Development of all three forms of "knowing" is involved in the evolution of an efficient learner.

Apparently awareness of "knowing" and of memory itself is of primary importance. If an individual child has no awareness of memory acts or has failed to develop an awareness of a "mnemonic self," it is highly unlikely that he will exhibit any learning behaviors which are appropriate to the demands of various classroom tasks (Hagen, Jongeward & Krail, 1975). According to Brown (1974), the developmentally young do not spontaneously adopt appropriate plans for memorizing nor do they according to Flavell, Friedricks & Hoyt (1970) possess the degree of insight into the workings of their own memory to appreciate this fact.

Through maturation and experience, children become increasingly aware and active in directing their own learning efforts. Initially, a young child remains passive and may merely identify or label incoming information. "The deliberate intention to memorize perceptual inputs for later recall only gradually emerges and articulates itself from the less deliberate intent to recognize and contemplate them" (Flavell, 1970, p. 338). Eventually the learner's attachment of meaning to cognitive or environmental events enables him to engage in the initial act of "knowing." The child's awareness of the process of semantic attachment enables him to better direct perceptual input and to gain greater control over cognitive or environmental stimulation.

The developing ability to accurately monitor and manipulate the organization of information for subsequent recall, reflects the child's developing repertoire of skills for "knowing about knowing." It is generally concluded that in order to produce an effective memory plan, the individual must be cognizant of the parameters of his own

memory abilities; he must recognize and correctly appraise the learning task; and he must evaluate the interaction between his abilities and the task to be performed. Flavell (1971) has coined the term "metamemory" to describe this aspect of cognitive functioning. The extent to which a child inaccurately assesses his own "knowing" relative to the demands of that task will necessarily influence his success on that task. If the learner fails to accurately evaluate the task demands in relation to his own memory abilities, he will also fail to deploy appropriate learning strategies to facilitate his performance. The development of "knowing about knowing" then involves the growing child's differentiated awareness of himself as a learner and his differentiated awareness of the characteristics of learning problems. Evident age-related changes in memory behaviors come about as a result of a maturing cognitive system confronting, mediating and resolving the learning demands of the environment.

Brown (1975) has suggested that the development of "knowing how to know" involves not only the learner's ability to plan his performance in advance but also his ability to "plan to execute a plan." "Knowing how to know" suggests that there is intent on the part of the learner to be strategic in managing his own learning. Brown (1974) has concluded "that the general intention of using a strategy" is closely tied to the learner's overall level of maturation.

A survey of current research findings from a variety of investigations into the development of memory indicates that there is a growing body of evidence to support Brown's (1975) hypothesized age-related changes in memory functioning. Moreover, these develop-

mental differences in memory awareness and memory monitoring are thought to account for the observed performance differences among normal children of different ages as well as for differences between mentally retarded children and normal learners. It is generally assumed that the growing child acquires and utilizes mnemonic techniques partly in response to his own increasing cognitive maturity and partly in response to the environmental demands placed on his cognitive functioning. Spontaneous generation and utilization of memory strategies is uncommon in young children; however, it increases dramatically during the elementary school years. As normal learners experience the demands of formal schooling, they become increasingly organized and strategic in their solutions to memory problems (Cole, Frankel, & Sharp, 1971; Liberty & Ornstein, 1973; Hagen, 1971). In general they become more adaptive in their approach to problem solving and more task specific in their approach to memory problems (Spitz & Nadler, 1974). Both the ability to accurately identify a memory problem and the subsequent generation of organizational strategies for facilitating performance show a marked increase during the school-aged years (Hagen, et al., 1975).

Development of general memory awareness among retarded children

Eyde & Altman (1978) conducted a series of research investigations which were designed to examine hypothesized developmental differences in the memory awareness of mild and moderately retarded children. Since the ability to differentiate perceptual processing from more active attempts to memorize specific information has been demonstrated to be an age-related phenomenon among normal learners, it was anticipated that the type of instructions given for a memory task would result in significant performance differences in the

developmentally delayed learners.

One hundred twenty mild and moderately retarded children between the ages of five and 16 years were selected to participate in the studies. The subjects were grouped according to ability level (high IQ, 60 - 75 and low IQ, 44 - 59) and according to younger and older age groups (5 - 10 years and 11 - 16 years). The ability x age groups were randomly assigned to three levels of pre-task instructions (instructions to "look" at task materials, instructions to "remember" task materials and no instructions for the task). The task involved 16 black and white line drawings of common items. The 16 items were selected from four categories of objects, e.g. tools, animals, fruits and playground equipment. A 2 x 2 x 3 factorial design was employed in order to evaluate the effects of age, ability and pre-task instructions on the study behaviors, number of items recalled and the strategy of recall manifested in the performance of the subjects.

Statistical analysis of the results indicated that the type of direction given for a memory recall task had little or no impact on the retarded child's performance of the task. This failure may have reflected a ceiling effect for the task or it may also reflect the pervasive, undifferentiated approach to memory problems typified by developmentally immature memorizers including the retarded learners.

The results, however, did clearly demonstrate that the child's age and age combined with ability did differentially affect performance relative to both the total number of items recalled and the degree of organization or categorical clustering in the recall. The finding that older subjects recalled more items and exhibited a greater amount of organization in their recall was consistent with

previous research findings reported for normal learners. It may be concluded that the number of items which a child can remember and the amount of organization in his recall are both increasingly a function of age and experience (Cole, et al., 1971; Moely, Olson, Halwes & Flavell, 1969; Nelson, 1969; Niemark, Slotnick & Ulrich, 1971; Yussen, Gagne, Gargrielo & Kuner, 1974).

Thus, theoretically and empirically, it is the case that improved memory organization results in improved recall performance. Both measures should evidence an increase with increased age. An analysis of the observed interaction of age and ability level in this study indicated that the differences in performance for older children were significantly greater than those of younger subjects. The older, higher ability subjects recalled almost twice as many items and manifested almost twice as much clustering in their recall.

The assumption that a child will not develop efficient skills for processing information in an experiential vacuum is corraborated by a significant interaction between age groups and ability levels. The magnitude of the performance differences suggests that higher ability, older children have benefited both quantitatively and qualitatively from their school experiences.

Although the literature clearly illustrates that memory development involves the propensity to spontaneously generate and utilize mnemonic subroutines, an analysis of the variables of age, ability and pre-task instructions indicates that in this study only ability level (IQ) was significant. Higher ability subjects generally exhibited more strategic task adaptive behavior in preparation for recall-

ing the memory items. They exhibited verbal rehearsal of memory items more often during the study period and arranged the memory cards into categorical groups more often. Since both rehearsal and grouping of items facilitated recall on this task, it was concluded that higher ability children engaged in more appropriate task behavior, i.e., "knowing about knowing" than did lower ability children. One can only conclude as Hagen (1971) and others have concluded "changes occur in memory performance not simply as a function of maturation at the physiological level, but also at a psychological level." Age alone will not account for performance differences. The frequency of appropriate study behaviors increased from three in the 5 - 7 year old group to ten in the 8 - 10 age group, to eleven in the 11 - 13 age group, then decreased to three for the 14 - 16 age group which suggests support for Vaughan's (1968) assertion that the degree of organization imposed on input is an age-related but not an age-dependent variable. The data from the study under discussion suggest that it is more generally the case that retarded children, regardless of their chronological age, employ strategies which are more characteristic of the developmentally young memorizer. One may conclude that their unprompted study behavior is generally undifferentiated and strategic techniques are rare even among older children. (Only 20% of the total sample exhibited any identifiable mnemonic technique in preparation for the recall task).

Lastly, in this phase of research each subject was asked subsequent to the recall test which type of organization would facilitate remembering the 16 items. The choices on three questions were represented by display cards representing either categorical group items

or randomly grouped items. The majority of children choose the categorical array. Although this result may also reflect a ceiling effect, it may be the case that the ability to spontaneously use mnemonic strategies lags somewhat behind the ability to identify those strategies. Jensen (1971) found that normal children who did not group items into categories during recall could easily recognize the organizational properties of the memory materials independent of their recall performance.

In summary, the analysis of the data in this investigation indicates that age is a significant factor in the recall performance of retarded learners, both quantitatively and qualitatively. Moreover, while chronological age apparently influences memory behaviors, cognitive maturity combined with experiential history results in even more efficient memory performance. Subsequent data analysis revealed that ability level and age variables also significantly influenced the type of preparatory study behavior manifested by the subjects in this experiment. A post-hoc Chi Square tests was applied to four age group blocks (5 - 7, 8 - 10, 11 - 13 and 14 - 16 years). Significant differences in study behaviors occur somewhere in the 8 - 13 year old range. While most retarded children were able to easily identify the metamemory properties of the recall test this knowledge was not systematically related to their preparation for the recall test. Lastly, within this study, metamemorial knowledge and memory capacities as manifested in performance scores were not found to be correlated.

General development of metamemory in normal learners

The most comprehensive study of metamemorial development among

normal learners has been conducted by Kreutzer, Leonard & Flavell (1975). The authors interviewed kindergarten, first, third, and fifth grade students (20 at each level) to determine their knowledge of a variety of memory phenomena. The metamemorial functionings of the various age groups were inferred by the subjects' responses to a number of interview protocols. The interviews, fourteen in all, focused on three broad categories of metamemorial behaviors which are very similar to Brown's (1975) cognitive groupings of "knowing," "knowing about knowing," and "knowing how to know." The first group of interviews dealt with the child's differentiated awareness of himself as an active user of mnemonic techniques. The second group of interviews related to the child's identification and evaluation of various task variables. The third category focused on the acquisition or development of a set of memory strategies to facilitate deliberate memorization.

The general results of the Kreutzer, et al., (1975) structured interviews indicated that metamemory or the knowledge of one's own memory process does exhibit a developmental course. An equally interesting conclusion from the study was the apparent reliance of young children on external storage and retrieval devices to supplement their own memory functions. Systematic emphasis on external, environmental facilities for boosting memory capacity is an unknown but potentially important component in educational programs for the developmentally young or developmentally delayed learner. While it is fairly obvious that total reliance on external resources is not practical, their ability to serve as memory aids should constitute a minimal instructional goal. More importantly from a remedial view-

point, direct and systematic instruction in the use of external supports such as notes, lists, objects, environmental cues, and other people is feasible within the constraints of the average classroom.

General development of metamemory among retarded

Since the identification of metamemorial knowledge among developing children is a fairly recent phenomenon, research studies in this area are relatively sparse. Two studies make up the bulk of known data. The first study represents an experimental investigation by Brown & Barclay (1976) which focused on training retarded learners on specific metamemory processes. The second investigation was an exploratory study by Eyde & Altman (1978) which focused on specific metamemory behaviors exhibited by mild and moderately retarded school-aged children.

Brown & Barclay (1976) in order to explore the effects of menmonic training devided mildly retarded children into two groups composed of younger and older mental ages (Mean MA 6 years 8 months and Mean MA 8 years 5 months). Equal number of subjects were given instructions in anticipation, rehearsal techniques or labeling strategies. The effects of training on recall readiness were assessed following a total of seven days of training. Both anticipation and rehearsal training resulted in improved performance while labeling did not improve recall readiness. This result appeared to indicate that it was the self-testing or monitoring features of anticipation and cumulative rehearsal which facilitated the retarded child's performance. The training on a mnemonic technique not only facilitated memory performance but for the older children their improvement was substained for two weeks without additional instruction. Brown & Barclay con-

cluded that younger subjects didn't just abandon their mnemonic training but rather that they failed to appreciate its utility. Thus, chronological age as well as mental age is concluded to be important in metamemorial training even among retarded. Younger children because of limited experiences may need more explicit instruction in both effective mnemonic techniques and in their appropriate use before they successfully monitor their own memory behavior.

Concurrent with the investigation of general memory awareness among retarded populations, Eyde & Altman (1978) undertook an exploration of metamemorial knowledge among retarded learners. This exploratory quantification of metamemory skills was achieved through the administration of several structured interviews and stimulated memory problems. The interview protocols were largely based upon similar interviews conducted by Kreutzer, et al., 1975 with normal children. Their monograph entitled An Interview Study of Children's Knowledge About Memory provided the conceptual and procedural framework for Eyde & Altman (1978) metamemory research among retarded children.

The investigation of Eyde & Altman (1978) focused on the following mnemonically relevant properties: (1) awareness of memory variability; (2) the amount of material to be memorized; (3) past familiarity of the material; (4) colored vs black and white stimuli; (5) amount of study time available; (6) opportunity for rehearsal; (7) recall of objects vs recall of events; and (8) the importance of the presentation format of material to be memorized. In addition,

this study explored the various methods deployed by retarded learners when they are confronted with common memory problems involving organization of information.

The interviews were administered to 120 mild and moderately retarded children, ages 5 - 16 years. The chronological age groups were further organized into four age blocks of 5 - 7 years, 8 - 10 years, 11 - 13 years and 14 - 16 years with intervals of three years between the groups and with 30 children in each group.

Since comparative analysis of the metamemory phenomenon along both the chronological age and mental age continua was of interest. The subjects' responses were also analyzed with respect to their mental ages (MA). The range of mental ages exhibited by children in this study was from 41 months to 143 months. The responses of the subjects were assigned to groups reflecting LOW, MEDIUM or HIGH mental age. The low group ranged from 41 to 76 months with a mean MA of 60.18 and an N = 60. The medium group ranged from 79 - 112 months with a mean MA of 91.00 months and an N = 48. The high group ranged from 113 - 143 months with a mean MA of 123.27 and an N = 12. Obviously there was not an equal number of subjects in each block. However, this grouping by MA, roughly represents three levels of cognitive maturity, i.e., five years, eight years, and ten years. Thus, the data analysis of this study entailed an examination of the comparative degrees of childrens' metamemorial knowledge relative to four levels of chronological age and three levels of mental age. In all instances, subjects' responses were organized in contingency tables and evaluated by Chi Square tests of significance with a p value of less than .05 established as a level of significance.

Since a primary focus of the metamemory research was verification and quantification of the phenomenon, the following results of the interviews are summarized in a critical fashion. The purpose is to report the relevant findings as well as identify certain methodological concerns which became evident in the course of investigation. The overall results of the interviews indicated that the mentally retarded children in this sample were, in fact, aware of a number of metamemorial processes. It was also evident, however, that certain interview protocols were more sensitive than others in detecting existent developmental differences. Despite the pictorial support of the interview materials, it appears to be the case that the verbal demands of certain interviews were beyond the language capacity of the younger, lower functioning children. Given the parallel development of language skills, it was not surprising that higher ability children were able to describe their own memory acts in a much richer fashion.

It is much more difficult to distinguish metamemorial awareness in retarded children from their abilities to use language as a tool for introspective evaluation of their own acts of knowing. Perhaps the two processes, language development and cognitive development, are so interdependent that it is difficult to sort out their relative influence on metamemory functions. At times, the language delays of many retarded children make the results of this investigation difficult to interpret. Thus, many of the interpretations which are offered bear more on the needs for future research in special education than on formulating an unequivocal set of conclusions. The results of the study are as follows.

In the first interview entitled Memory Awareness, children were asked questions concerning the variability of memory and their own comparative memory capacities. Older children more than younger children apparently perceived memory capacity as something which does vary between individuals and across situations. Moreover, older children seemed to be aware of forgetting whereas younger children steadfastly denied this other side of the memory coin. Interestingly enough, younger children did state that information concerning appropriate control of their own behaviors was especially difficult for them to remember. Generally, it was apparent in this interview that mentally retarded children are aware of memory variability and capacity problems.

With respect to future research, the quality of the data derived from this interview could be improved by using less open-ended formats. A forced choice list of various memory demands, e.g., things at school, things at play, things which happened a long time ago, things which happened today, would facilitate statistical analysis and reduce the verbal demands placed on the respondent. This interview in its present form required the child to engage in many comparative, sometimes abstract, generalizations. In all probability, the younger and lower functioning children were unnecessarily penalized by the verbal demands of the interview format.

The Recall-Judgement interview was designed to probe two relatively simple metamemorial skills: (1) an individual's evaluation of memory capacity limitations; and (2) an individual's prediction of his own memory span. The first task required the child merely to judge the relative difficulty of amounts of material to be memorized.

The second task required the child to accurately monitor his own memory capacity relative to those items. The results of this interview revealed that, by and large, older children were far more accurate in evaluating their memory capacity limitations. Obviously, the older child has had an increased opportunity to experience various capacity demands and has apparently benefited from these experiences. It is noteworthy that even retarded learners benefit from such experiences. If the retarded child has acquired this knowledge (i.e. accurate estimates of his capacity limitations) incidentally in school related experiences, then the possibilities for improving accuracy in evaluating memory demands by systematic instruction in the classroom take on added promise.

The responses to the second task which required the subject to monitor his own memory ability were not significantly related to either age or ability. Whether this result reflects a general failure on the part of the retarded to actively monitor their own memory behaviors or merely a failure to understand the instructions for the task is unclear.

In the Kreutzer, et al., (1975) study, the physical spacing of memory list items was not significantly related to the children's evaluation of difficulty of the task. However, the mentally retarded child may have been responding to the physical size of the lengths of the list of memory items instead of the actual amount of material to be memorized. Future research should investigate this type of span prediction among the retarded using lists of equal physical length which vary only in the amount of material depicted within the lists. Lists of meaningful items and nonmeaningful items should also

be utilized so as to determine if span prediction evaluations are influenced by the meaningfulness or familiarity with the depicted items.

The pattern of responses resulting from the Colored-Uncolored interview clearly demonstrates that the majority of retarded children perceive color to be mnemonically relevant. A number of children stated that one "notices" or "sees" colored items better than the same items rendered in black and white. The suggestion that color per se engages the child's attention more forcefully is interesting. It may suggest that the retarded learner is at least minimally aware of some sort of attention deficit. If this is the case, then perhaps there is some optimal point along a colored-uncolored continuum which engages attention and facilitates organization. Thus the child could participate in the design of his own instructional materials so as to maximize his learning. The learner then could be a partner in customizing of information organization.

In future research it would be especially beneficial to measure the child's actual memory performance on colored and uncolored items. Recall items can be designed so that color is gradually faded into black and white renderings. Measures of performance could be taken at different intervals along a colored-uncolored continuum. Moreover, there is some indication that lower ability children were able to more readily attach meaning to the colored items. This initial attachment of meaning is critical in the memory act since the meaningfullness of items facilitates information processing at successively deeper levels of analysis, e.g. Craik & Lockhart (1972). Since black and white print represent an abstraction from experience, it may be

beneficial to break this abstraction into progressively smaller units so the low functioning child could gradually assimilate the information, for example in reading material.

A failure to find significant factors in the responses to the Relearning interview indicates that this particular task was not sensitive to developmental differences in this investigation. This interview was designed for measuring the phenomenon of "savings" in memory. "Savings" involves the amount of time necessary to "learn" previously learned material as opposed to new material. An examination of the protocols reveals that the items which were designated as "old items" had the same stimulus value as the "new items." That is, it is likely that the single trial exposure to "old items" did not constitute learning for the retarded child. Support for this assumption is provided by the randomness of the response choices. Brown (1973) has found that recency judgements in recall tasks are generally insensitive to developmental differences. Because the "old items" used in the comparative evaluation of relearning were not mastered in the memory recall task, some children were likely making a judgement as to recency, i.e. previously seen items. In order to obtain a valid measure of "savings" and its relationship to the amount of study time needed for learning it will be necessary to teach memory items to a pre-established criterion level. Subsequently, ask the child to compare the relative difficulty of relearning this "older" material as compared to learning "new" material.

In the interview Immediate-Delay, awareness of the limitations of short term memory and the need for rehearsal was examined. Children were told that they needed to give their teacher a phone number. They were then given a variety of options of how they could go about the task of remembering the phone number.

Their responses indicated that increased understanding of the rapid loss of information stored in short-term memory appears to increase with age. The results of the Immediate-Delay interview indicate that at least older retarded children were aware of this aspect of memory. Younger children had difficulty in responding to the interview questions. At first glance it seems that the verbal demands of the task were beyond the capacity of the younger, low functioning children. However, in the initial Memory Awareness interviews older children acknowledged that they forget material whereas younger children tended to deny that they ever forget. The fact that older children are more aware of the possibility of forgetting might have influenced their approach to the Immediate-Delay task. However, none of the children described techniques or made choices which reflected rehearsal activity.

In future measurement of the metamemorial awareness of short-term memory delay, it may be preferable to use pictures to support the various choice options. For example, the act of looking and telling the number right away, rehearsing the numbers, or other options could be graphically represented.

The questions on the Preparation interviews probed the type of preparation for remembering typically used by retarded children when confronted with daily memory problems. The results revealed that older children were more generally planful irrespective of their ability level. Moreover, retarded children in general rely on other people in their environment to remember things for them. However, the results from the earlier phase of memory research indicated that, in fact, only higher ability children organized their study behaviors

in an efficient manner. Thus, knowing about ways to plan for remembering and knowing how to spontaneously use that knowledge in a task adaptive manner are apparently different aspects of the memory process. In fact, the general failure of retarded learners to use such preparation, or to use inefficient plans, suggests that the problem lies more in what has frequently been termed the "executive control" problem or failure in the intent to be strategic.

Now that the preliminary data on general planfulness is available, it will be necessary to further quantify the various plans used by retarded learners. For example, certain strategies may be maximally beneficial at certain developmental levels, or certain strategies may be more appropriate for particular items and events.

Summary and Conslusions

The literature reviewed in this paper along with the results of Eyde & Altman's (1978) investigation of the development of general memory awareness or "knowing" among retarded children confirm that a child's total memory performance profile is a function of both chronological and mental age. This finding is consistent with descriptions of memory development among normal children. The two populations exhibit similar developmental characteristics relative to memory behaviors. It would appear to be the case that the memory acts of growing children are best viewed as a transactional process. That is, the developmental level of the child mediates between the child's memory capacity and environmental demands.

The results of the experimental phases of memory research suggest that changes in memory abilities come about through adaptation to the learning environment. The mutual interplay between the cognitive

processes of assimilation and accomodation results in task adaptive memory strategies. However, the generally observed passivity of developmentally immature memorizers and their subsequent failure to monitor their own performances is suggestive of excessive accomodation to environmental events. It may be speculated that the "intent to be strategic" or "plan to execute a plan" is most characteristic of the assimulative function of metamemory.

The significant main effects relative to chronological age at both high and low ability levels illustrate the operation of the experiential characteristics of the memory act for even retarded learners. The interaction effect of age and ability further demonstrates the developmental limitation of processing experiences. Among other things chronological age is a bench mark of experiential history and apparently influences the degree of organization in recalled information but ability to benefit from experience is also important. Cognitive maturity or ability level combined with experiential history resulted in even more efficient single trial learning. In a very real sense, it is probable that what a child learns or is able to process on a single trial is a function, in part, of what he already knows.

The practical implications of these concepts may be in providing classroom experiences which appropriately match the learner's capacity to process information to the learning task. The nonretarded child apparently is able to abstract from his learning experience and generalize task adaptive strategies across learning situations. The normal child apparently benefits from a variety of "knowing" experiences, constructs a repertoire of knowledge relative to

"knowing about knowing" and eventually develops knowledge relative to "knowing how to know."

Similarly, the memory behaviors of retarded children reflect developmental differences in "knowing." The rate of change is much slower at the lower ability levels but it does occur. Moreover, retarded children are capable of recognizing a number of mnemonic variables which reflect in part their knowledge of various aspects of information processing or "knowing about knowing." The fact that retarded learners generally do not spontaneously use this knowledge in a task adaptive manner suggests that it may be necessary to systematically teach not only strategies for organizing, sorting and retrieving information but also to teach strategies for "knowing how to know." It may be necessary to concretely demonstrate to the retarded child the similarities and differences in acts of "knowing" across a number of learning trails and across a variety of situations which will increase his repertoire of "knowing about knowing" and hopefully promote the development of "knowing how to know."

The overall pattern of results obtained in the metamemory phase of research suggest that the individual's knowledge of "knowing about knowing" is closely tied to his experiences and his ability to benefit from those experiences. Moreover, his ability to benefit from those experiences may be closely tied to his level of language development. The findings suggest that these processes may be modifiable and enhanced if learning tasks are designated in such a way so as to maximize the match between the learner, his language, and the learning experience. In order to achieve this end, educators must shift part of the instructional focus from the <u>products</u> of

learning to the processes or transactions evident in the learning act. In the future we as practitioners must somehow arrange classroom experiences in such a manner so as to promote development in all three major knowledge systems which Brown (1975) has identified; i.e. "knowing," "knowing about knowing," and "knowing how to know" if we are to provide effective remedial and compensatory services to developmentally delayed learners.

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